

An Indian-Australian research partnership

<b>Project Title:</b>	<b>Inkjet printed organic electronic devices</b>	
<b>Project Number</b>	<b>IMURA0387</b>	
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## Research Academy Themes:

### Highlight which of the Academy's Theme(s) this project will address?

(Feel free to nominate more than one. For more information, see [www.iitbmonash.org](http://www.iitbmonash.org))

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure Engineering
3. [Clean Energy](#)
4. Water
5. [Nanotechnology](#)
6. Biotechnology and Stem Cell Research

## The research problem

Define the problem:

Inkjet printing is an emergent promising technique that has so many attractive features like direct writing, non-contact, less material wastage, digitally assisted, additive nature, scalability, low and large volume manufacturing capability and compatibility to flexible substrates. These attributes make inkjet printing a very cost-effective technique in comparison to traditional semiconductor manufacturing methods. This project thus aims to utilize these beneficial features of inkjet printing in fabrication of organic electronic devices like solar cells (**Project A**) and thin film transistors (**Project B**). In order to optimize the process for achieving device quality continuous and uniform films, few important things have to be given consideration. First, the non-contact nature of ink jet printing makes the print quality highly dependent on the ink substrate interactions. Such interactions are sensitively affected by the surface condition of the substrate, ink

formulation, wetting of the substrate surface under forced ink drop impact, fluid mechanism after printing and ink adhesion. Therefore combined investigation of substrate surface chemistry, ink formulation, wetting and dewetting will need to be studied against the electrical properties of the printed device. Second, substrate surface electrostatic charge is a significant factor that may affect the trajectory of the ink drops. Understanding and controlling the substrate surface charge will contribute to the improvement of printing resolution. The devices fabricated after this optimization will be electrically characterized and efforts will be put in maximizing the performance parameters.

## Project aims

*Define the aims of the project*

Broadly, the project aims to achieve following objectives:

- Surface characterization of the substrate
- Understanding ink-substrate interaction and developing suitable ink formulations for each functional layer
- Understanding drop ejection process through inkjet nozzles
- Optimization of the printing conditions to obtain continuous, smooth and uniform films with the desired morphology
- Device fabrication and characterization

However, the project is divided into two sub-projects (Project A and Project B) based on the selected device. These are mentioned below:

**Project A:** In this project, the student will focus on organic solar cells.

**Project B:** In this project, the student will focus on organic thin film transistors.

## Expected outcomes

*Highlight the expected outcomes of the project*

- Development of process integration scheme that will be helpful in inkjet printing of various new materials and new designs of electronic devices.
- Demonstration of inkjet printed devices

## How will the project address the Goals of the above Themes?

*Describe how the project will address the goals of one or more of the 6 Themes listed above.*

In this project, both the materials and processes involve nanotechnology. The materials will be mostly nanoparticle inks and understanding their inkjetting process requires a significant understanding of fluidics and the obtained nanomorphology. Further the project aims to fabricate devices to produce clean energy via organic solar cells and through cleaner routes.

## Capabilities and Degrees Required

*List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These*

*capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.*

We are looking for **two (2)** Ph.D. students, one for project A and another for project B, having background in:

1. Surface and thin film characterization techniques, materials chemistry.
2. B-Tech or M.Tech in Materials Science & Engineering/ Chemical Engineering /Electrical Engineering
3. M.Sc in Physics and Chemistry